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TRANSMITTAL OF CONTINUING APPLICATION

Commissioner for Patents
Box Patent Application
Washington, D.C. 20231

Sir:

This application is a [ ] continuation [x] divisional [ ] continuation-in-part application filed under the procedure set forth in 37 CFR 1.53(b).

1. PRIOR APPLICATION DATA

Application No: 09/171,370 Filing Date: October 16, 1998

Title: PROCESS FOR PRODUCING THREE-DIMENSIONAL KNITTED FABRICS AND TEXTILE MATERIAL THUS PRODUCED

Applicant: Friedrich ROELL

2. ENCLOSED ARE:

- [x] Fee Transmittal Form (in duplicate)
- [x] 9 pages description, 3 page(s) claims, 1 page abstract [Total Pages: 13]
- [x] 2 sheet(s) drawings
- [x] Declaration for Patent Application
  - [ ] Newly executed
  - [x] Copy from prior application
- [ ] An assignment and recordation cover sheet
- [ ] Small entity status: verified statement that this is a filing by a small entity under 37 C.F.R. 1.9 and 1.27.
- [ ] Preliminary Amendment
- [x] Information Disclosure Statement

3. [x] Cancel in this application original claims 3-5, 8-12 and 14-16 before calculating the filing fee.

4. [ ] This divisional or continuation application is filed by fewer than all of the inventors named in the prior application and this application is accompanied by a statement requesting deletion of the name(s) of the person(s) who is(are) not inventor(s) in this application.

5. [ ] The [ ] inventorship, [ ] inventor's citizenship, residence or post office address as shown on the original oath or declaration was changed and approved during prosecution of the prior application, which changes are shown on the enclosed Inventor(s) Information Sheet.

6. [x] Priority of Application No. 196 16 005.7 filed on April 18, 1996 in Germany is claimed under 35 USC 119.

[x] A certified copy of the priority application has been filed in prior Application No. 09/171,370 filed October 16, 1998.

7. [x] The prior application is assigned of record to Recaro GmbH & Co. (For divisional or continuation only; not for CIP.)

8. [ ] A petition and fee for _____ month's extension of time to respond to the Office Action mailed _____ in the prior application, until _____, has been filed, and a copy of the petition is attached.

9. [ ] A verified statement claiming small entity status has been filed in prior Application No._____ filed _____. A copy of the verified statement is enclosed. Status as a small entity is still proper and is desired.

10. [x] Address all future communications to the correspondence address associated with Customer No. 007812.

By _____
John Smith-Hill, Reg. No. 27,730
[x] Attorney or Agent of Record
[ ] Filed under 37 CFR 1.34(a)

Telephone (503) 574-3100
Facsimile (503) 574-3197

Method of Producing a Three-Dimensional Knit and Textile Material produced thereby

The invention relates to a method of producing a three-dimensional knit, i.e. a knit whose surface area is shaped spatially, as is the case of e.g. balaclava helmets or sock heels, shaping being achieved by accepted practice in loops being widened and/or narrowed in specific portions of the knit.

It is in the marginal portion of such widening or narrowing that inhomogeneities materialize due especially to the normal, i.e. not knitted three-dimensionally, knit being tensioned or deformed in the marginal portion of the three-dimensionally knitted area. Accordingly, these marginal portions represent a weakened zone having the tendency to open up when exposed to mechanical stress.

It is thus the object of the present invention to provide a three-dimensional knit which is relatively insensitive all over to mechanical stresses.

This object is achieved in accordance with the invention by a method as it reads from claims 1 and 6. Advantageous further embodiments of the invention read from the corresponding sub-claims. The object is achieved furthermore by a textile material produced by any of the claims of the method. The invention relates more particularly to the production of industrial textiles.

In accordance with the invention widening or narrowing the loops is no longer done in a single defined portion, but at many locations preferably distributed homogeneously in the shaping area. In this way shaping is integrated homogeneously in the knit, i.e.

excessively stressed margins no longer occur in the marginal portion of a closely defined shaping area which tend to break prematurely.

The art in accordance with the invention permits production of all possible shapes such as e.g. spherical or dished shapes without e.g. as in the conventional fashioning technique a line existing within which all loops are reduced, resulting in the knit being subjected to particular stresses in the region of this line. Due to the invention, widening or narrowing or inactivating needles is distributed over the complete portion to be shaped so that the deformation of the knit no longer occurs along a line, it instead being homogeneously distributed over the complete knit. Furthermore, the deformation at each and every widening or narrowing location or needle inactivating/activating is no longer so pronounced since due to the plurality of locations widening/narrowing/inactivation becomes less at each location, i.e. the deformation of the knit at any widening/narrowing/inactivation location is less than in prior art in which all widening/narrowing/inactivation needed for shaping was done at only a single or a few locations.

These locations as cited above are now homogeneously distributed by the invention over the portion to be shaped, this distribution being intended to be as even, i.e. homogeneous as possible. The distribution may be achieved regularly, i.e. controlled so that all widening/narrowing/inactivation locations are spaced away from each other more or less evenly. However, these locations may also be distributed statistically over the portion to be shaped, thus avoiding the creation of all and any texture possibly consistituing a design break point.

The degree of deformation is preferably controlled via the density, i.e. the mutual spacing of the locations where widening/narrowing/inactivation occurs. Should heavy deformation be desired, then these locations are arranged in a higher density than in portions in which less deformation is wanted. In this way homogeneous textile pieces may be produced comprising portions less and more deformed as desired, thus enabling homogeneous knits to be produced in any desired shape.

A basic distinction is made between two ways of producing three-dimensional textile structures. For one, a three-dimensional shape is achieved by widening and/or narrowing the loops in several portions of the knit, whereby the number of widened/narrowed or split/unified loops per location should not be excessive, e.g. not amount to more than ten loops. Widening several loops within the knit at several locations produces a bulge in the knit at the widening locations. Narrowing the loops in the knit at a plurality of locations causes the knit to pucker in this portion, again producing a bulged portion. Widening and narrowing may be combined as desired to achieve the desired shapes.

Another way of producing three-dimensional knits consists of rendering needles inactive in specific portions of the knit whilst knitting is continued with the needles in other portions. By later activating these inactivated needles, e.g. after one or more courses a puckering of the knit in this inactivated portion is achieved which in turn may be made use of to achieve specific shapes. When, for instance, in knitting the needles are made inactive in the marginal portions of the flat knitting machine, and this inactivation repeated on a spacing of a few courses differing in width, a spherical configuration is achieved having a highly homogeneous structure. In this case too,

inactivating the needles should be done only over a few courses to avoid excessively deforming the knit at any one location. Furthermore, the width (needle number) of inactivating may be alternatingly varied so that also by these means a distribution of the deformed locations may be achieved in the shaping portion, these locations being positioned at points at which an inactivated portion adjoins a fully knitted portion.

Both of the principles as cited above for producing geometric knits may be put to use with the method in accordance with the invention in that widening/narrowing the loops, on the one hand, or inactivating needles, on the other, is distributed to many locations in the shaping portion. In any case, a more homogeneous structure of the three-dimensional knit is achieved, on the one hand, which in turn has enhanced mechanical properties.

A distributed widening/narrowing of the loops within the knit may be achieved to advantage by using twin needles. For example, an alternating knit may be done with the A and B needles of the twin needles, resulting in a loop count corresponding to twice the number of active twin needles or conventional needles. When a reduction in the loop count is desired, knitting is continued only with one of the A or B needles of the twin needle. This results in the loop count being reduced to half for the same width of the active portion of the needle bed. This reduction may also be achieved in other steps when the reduction to one of the two needles of the twin needle is not implemented for every twin needle but e.g. only to ever second such needle. Likewise, an increase in the loop count may be achieved by changing from knitting with one of the two needles of the twin needle to knitting with both needles, the two

needles of the twin needle then being activated successively.

The invention will now be described by way of an example as illustrated schematically in the drawing in which:

Fig. 1 is a construction for knitting a spherical knit by inactivating needles in the marginal portion of the knit;

Fig. 2 is an illustration of a bulged portion achieved by widening and narrowing loops in one portion, and

Fig. 3 is a construction of a bulged portion achieved by widening and narrowing loops in accordance with the invention.

Referring now to Fig. 1 there is illustrated a construction for producing a roughly spherical knit, the actual knitted textile area 10 being evident from this Figure. Shaping the textile is achieved by inactivating needles partially or completely within a portion b on both sides of the textile area 10 so that in this portion knitting is not done over one or more needle rows. In subsequent reactivation of the needles the loops are then joined to the loops last knitted, i.e. specific portions of the courses are simply missing during the time in which activation of the needles in the marginal portion b of the knit 10 is lacking. Accordingly, the courses before and after the missing portion are simply knitted together, as a result of which the knit in this portion is puckered corresponding to the number of non-knitted courses. The points at which a deformation occurs in this arrangement are the points 11. At these points 11 the inactivated portions

adjoin the fully knitted portions, this being the reason why preferably the width of the inactivated portion, i.e. the number of inactivated needles is continuously varied so that also the deformation points 11 are homogeneously distributed within the shaping portion b. In this way a defined structuring of the reduction is avoided which in turn would involve a weakening of the knit. The mutual spacing of the inactivations 12, 14, 16 is relatively constant so that the deformation points 11 exhibit a more or less homogeneous spacing also in the interlooping direction.

In the construction as shown in Fig. 1 the needles are inactivated in a first short portion 12, covering for example only 20 needles. In a later portion, i.e. a couple of courses further, the loops are inactivated in a portion 14 extending over the full width b of the shaped portion. Inactivation in this case would involve e.g. 60 needles. Again a couple of courses later, the needles are activated over a width 13 located between the two widths as cited above, e.g. for 40 needles. The deformation points 11 are thus homogeneously distributed over the deformation width b. The inactivated portions 12, 14, 16 are always alternated with fully knitted portions 18 in which the knit is produced over the full width, resulting in more or less equispacing of the points 21 in the interlooping direction. Running through the middle of the knit 10 is a portion 20 which is fully knitted, whilst furthermore outwards a portion 22 extends in which the knit already comprises non-knitted courses at a spacing of several courses. These non-knitted portions widen in the outward direction as is easily appreciated from the drawing. When now envisaging the knitted portions 18 being joined to each other at their top and bottom edges, it will readily be appreciated that the knit as illustrated in Fig. 1 is roughly spherical in shape. Each inactivation 12, 14, 16

runs in the knit over two courses in sequence. It is, of course, just as possible to directly attach various inactivated portions 12, 14, 16 to each other without any fully knitted portions inbetween in wanting to achieve stronger shaping. The degree of shaping is set by the spacing, i.e. the sequence of the inactivations and the width of the inactivation portions 12, 14, 16. Thus, the wider the inactivation portions and inactivation sequence, the stronger is also the shaping.

Whilst Fig. 1 illustrates a method for producing three-dimensional knit structures by inactivating needles, Figs. 2 and 3 show a knitting method in which a three-dimensional shape is produced by widening or narrowing the loops. Fig. 2 illustrates a method in which three-dimensionally shaping the knit is done in a defined portion 30 where, namely, in a first stage 32 a loop is doubled, the loop being split into two loops so that instead of a single wale two wales now exist. At the location 34 the two wales are again split into two wales each so that now four wales exist which at the location 36 are yet again split up into eight wales. It is at this location that the portion 30 is widest. At the location 40 two loops each are puckered into a single loop, i.e. reduced, as a result of which after the location 40 only four wales exist. At the locations 42 and 44 a further reduction is made so that in the end only a single wale is again present. In the portion 46 about the three-dimensionally shaped portion 30 the knit is subjected to an increased mechanical stress due to the deformation in this marginal portion. This deformation involves premature fatigue, wear and tear of the material or greater susceptibility to mechanical stressing.

To get round this disadvantage the widening in accordance with the invention is not done in a portion

30, as shown in Fig. 2, but at five different locations 50, 52, 54, 56, 58 at each of which a loop is split up into two loops and subsequently recombined into a single loop. The splitting duration for the five locations differs, so that a homogeneous distribution of the widening/narrowing locations within the knit exists. Furthermore, between the widening/narrowing portions 50, 52, 54, 56, 58 fully knitted wales 60 are arranged serving to enhance the homogenity of the knit throughout the complete shaped portion.

It will readily be appreciated from comparing the prior art knit method to the new knit method that shaping the knit is substantially more homogeneous than in prior art and that such a knit is very much more resistant to mechanical stresses and premature material fatigue. In addition to this, the geometry of the three-dimensionally shaped portion may be better controlled by the invention, i.e. via the spacing of the locations 50, 52, 54, 56, 58 and via the widening/narrowing length at each single location 50, 52, 54, 56, 58. In the present example, the longest widening is undertaken in the middle portion, i.e. the portion most bulged, whereas in the adjoining locations 52, 56 the widening is not so long and in the marginal locations 50, 58 the widening is only relatively short, here, for instance, the widening/splitting extending over one to ten courses.

The present invention is thus suitable for producing all possible geometric shapes such as spheres, cones and all kinds of regularly and irregularly shaped bulges. Both widening/narrowing the loops and partially inactivating the needles in a course may be done in an unequal spacing and to a differing extent. It may furthermore be done controlled or statistically to achieve as high a homogenity as possible. Care is to be taken, however, in the distribution of these locations

and in the distribution of the extent of widening/narrowing/inactivation so that, in all, a more or less consistent shaping of the knit is achieved over the full area.

The two basic techniques of widening/narrowing, on the one hand, and fashioning, on the other, may, of course be optionally combined with each other.

CLAIMS

1. A method of producing a three-dimensional knit, i.e. a knit whose area is shaped spatially, said three-dimensional shaping being achieved by widening and/or narrowing loops in specific portions
characterized in that
said widening/narrowing of the loops is done at several locations arranged distributed.

2. The method as set forth in claim 1,
characterized in that
said widening/narrowing locations in a portion of equal deformation are spaced away from each other roughly equal.

3. The method as set forth in any of the preceding claims,
characterized in that
said degree of deformation is set via the area-specific density of the locations at which a widening/narrowing occurs.

4. The method as set forth in any of the preceding claims,
characterized in that
said locations are arranged statistically distributed in said portion.

5. The method as set forth in any of the preceding claims,
characterized in that
knitting is done with twin needles, the number of activated needles being selected differingly for each twin needle in said widening/narrowing portion and in the remaining knit.

6. A method of producing a three-dimensional knit, i.e. a knit whose area is shaped spatially characterized in that said three-dimensionally shaping is achieved by needles being rendered inactive in at least one portion to be shaped over at least one course at least in part and later reactivated, whilst in other portions knitting is done throughout, said inactivating/activating said needles in said portion to be shaped being done at many locations arranged distributed.

7. The method as set forth in claim 6, characterized in that total or partial needle inactivation is done in said portion equispaced by at least one to thirty courses.

8. The method as set forth in claims 6 or 7, characterized in that the wales at which inactivation is commenced are alternatingly changed within said portion for inactivations in sequence.

9. The method as set forth in claim 8, characterized in that said change is made statistically distributed.

10. A method of producing a three-dimensional knit, i.e. a knit whose area is shaped spatially characterized by a combination of the methods as set forth in claims 1 and 6.

11. The method as set forth in any of the preceding claims, employing a flat knitting machine with twin needles, characterized in that

unlike the remaining knit, knitting is done in said widening/narrowing portion with both needles of said twin needle successively.

12. The method as set forth in any of the preceding claims, employing a flat knitting machine with twin needles,
characterized in that
in the fashioning or widening/narrowing portion knitting is done with a higher strength than in the remaining portion.

13. The method as set forth in claim 6
characterized in that
on a flat knitting machine having single needle drive several fashioning portions distributed over the width of the needle bed are fabricated synchronously.

14. A knit produced as set forth in any of the preceding claims.

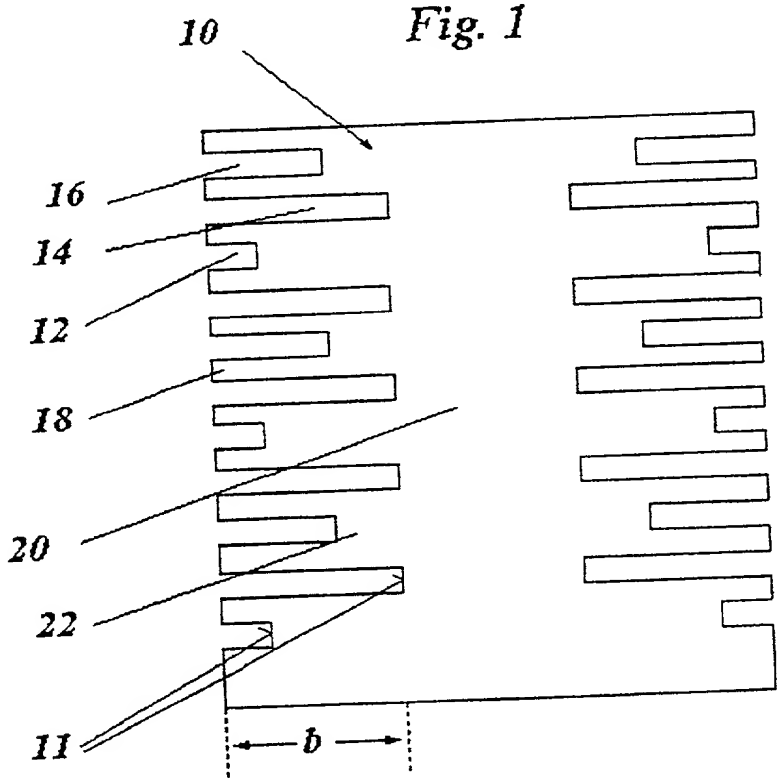
15. The knit as set forth in claim 14, comprising alternating plies/areas
characterized in that
the density of said locations for widening/narrowing loops or inactivating needles in a ply/area is higher than in the other ply/area.

16. Use of said knit as set forth in claim 14 or 15 for producing the fabric ply for a knitted helmet dome.

Abstract

The present invention relates to a method of producing a three-dimensional knit, i.e. a knit whose area is shaped spatially. In accordance with the invention a homogeneously tough three-dimensional knit structure is achieved when loops in specific portions are widened and/ or narrowed, this widening/narrowing of the loops being done at many locations arranged distributed homogeneously over the area to be formed three-dimensionally. In the same way a three-dimensional knit may be produced in which the knitting needles are inactivated at least in part over at least one course in the portion to be shaped and later reactivated whilst in the other portions full knitting is continued.

Fig. 1



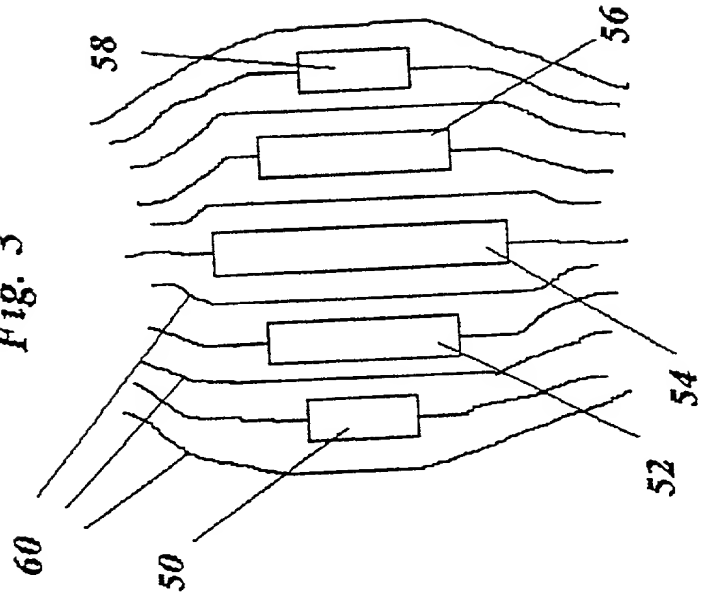


Fig. 3

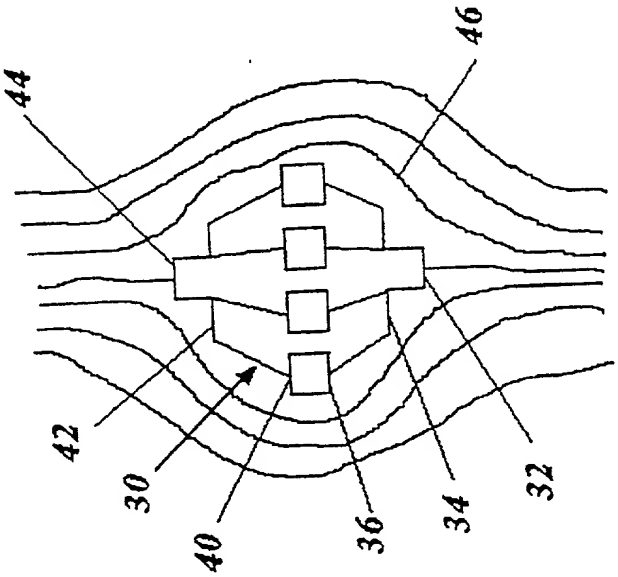


Fig. 2

Attorney's Docket No. 1782

DECLARATION FOR PATENT APPLICATION
(COMBINED WITH POWER OF ATTORNEY)
(ORIGINAL APPLICATION)

As a below named inventor, I hereby declare that:

My residence, post office address, and citizenship are as stated below next to my name. I believe I am the original, first, and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

PROCESS FOR PRODUCING THREE-DIMENSIONAL KNITTED FABRICS AND TEXTILE MATERIAL THUS PRODUCED

the specification of which is attached hereto unless box (a) or (b) is checked, in which case

(a) [ ] the specification was filed on _____ as Application No. _____.

(b) [x] the specification was filed as PCT International Application No. PCT/DE97/00792 filed on 18 April 1997 and was amended under PCT Art. 19 on _____ (if any).

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose to the Patent and Trademark Office all information known to me to be material to patentability as defined in Title 37, Code of Federal Regulations, Sec. 1.56.

I have identified below any foreign application(s) for patent or inventor's certificate or any PCT international application(s) designating at least one country other than the United States of America and filed less than 12 months (6 months for designs) prior to this United States application and of which I claim foreign priority benefits under Title 35, United States Code, Sec. 119, and I have also identified below any foreign application(s) for patent or inventor's certificate or any PCT international application(s) designating at least one country other than the United States of America filed by me on the same subject matter having a filing date before that of the application(s) of which priority is claimed.

EARLIEST FOREIGN APPLICATION, AND ALL FOREIGN APPLICATIONS FILED MORE THAN 12 MONTHS (6 MONTHS FOR DESIGN) PRIOR TO THIS U.S. APPLICATION

Country	Application No.	Date of Filing (MM/DD/YY)
Germany	196 16 005.7	04/18/96

As a named inventor, I hereby appoint the practitioners associated with **Customer Number 007812** (John Smith-Hill, Reg. No. 27,730 and Daniel J. Bedell, Reg. No. 30,156) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith and in connection with the resulting patent.

Send correspondence to the correspondence address associated with **Customer Number 007812**.

I hereby authorize the practitioners that I have appointed to accept instructions regarding this application and the resulting patent from ZIPSE & HABERSACK

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both under Title 18, United States Code, Sec. 1001, and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Full name of sole or first joint inventor Friedrich ROELL

Inventor's signature X Friedrich Roell

Date 11/10/1998 Country of Citizenship Germany

Residence Biberach, Germany

Post Office Address Fünf Linden 61

D-88400 Biberach, Germany

Full name of second joint inventor, if any _____

Inventor's signature _____

Date _____ Country of Citizenship _____

Residence _____

Post Office Address _____